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ABSTRACT

A learning style model, which identifies specific learning patterns of prospective teachers and teaching behaviors which relate to those identified learning patterns was tested on 20 female elementary education majors. The subjects were administered the Myers-Briggs Type Indicator, which determined the dominant personality type (Sensing/Thinking, Intuition/Thinking, Intuition/Feeling, Sensing/Feeling) indicated in the model. To determine the cognitive style dimension (field dependent/independent), the portable Rod and Frame Test, the Group Embedded Figures Test, and the Concealed Figures Test were administered. An individual electroencephalogram recorded subjects as they performed sequential-analytical and simultaneous-holistic (spatial) cognitive tasks associated with the left and right cerebral hemispheres. The subjects also kept self-analysis journals and discussed their learning patterns in the context of college courses and everyday living. Study results provide a basic framework upon which to build a theory describing the relationship between learning preference style and teaching preference style. A graphic depiction of the model is included. (JD)

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The Relationship Between Prospective Teacher's Learning Preference/Style and Teaching Preference/Style

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The Relationship Between Prospective Teachers' Learning Preference/Style and Teaching Preference/Style

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Educational literature has suggested relationships between a teachers' learning style and their teaching style (Gregorc, 1979; Anderson & Joyce, 1979; Dunn & Dunn, 1977). Generally speaking, however, to this date research has not provided a theoretical model nor reasonable evidence to support this relationship. The purpose of this paper is to describe a learning style model which identifies specific learning patterns of prospective teachers and then discusses teaching behaviors which relate to these identified learning patterns. Such a model should facilitate research towards substantiating this relationship. A theoretically based learning model (Figure 1) was developed which juxtaposes three conceptually related continue: neural processing dichotomies (assess by measuring patterns of brain activation using an electroencephalogram), cognitive style (measured by three tests of field dependence/independence), and personality (determined by the Myers-Briggs Type Indicator or MBTI).

Insert Figure 1 about here

The rationale for proposing the relationship between the continue is based upon three theoretical propositions:

1. Individuals organize, encode, and store information, employing at least two different modes or strategies, such as successive and simultaneous strategies (Das, Kirby, & Jarman, 1979), propositional and appositional strategies (Bogen, 1969), and analytic and holistic strategies.
2. Individuals differ in forms of cognitive functioning, which run through the perceptual and intellectual domains as well as that domain commonly conceived of as "personality" or social behavior (Witkin, Lewis, Hertzman, Machover, Meissner, & Wapner, 1954).
3. As a result of heredity, particular past life experiences, and the demands of the present environment, individuals develop learning styles based on basic differences in the way they prefer to perceive and process (i.e., judge) what has been experienced (Jung, 1971). According to Jung's theory (1923), all conscious cognitive activity can be classified into four mental processes: two perception processes (sensing and intuition) and two judgment processes (thinking and feeling). What an individual consciously perceives, comes either through his senses or through intuition. These perceptions are then

analyzed, evaluated and acted upon by one of two judgment processes: thinking or feeling. While individuals regularly use all four processes, one mental process dominates and is relied upon by individuals more than the others.

Learning Process Model

The learning process model is organized around these basic personality differences developed by Jung (1923) and interpreted by Myers (1962). This model incorporates these basic personality differences and places them on a continuum represented by intersecting vertical (how individuals perceive) and horizontal (how individuals process-judge) lines. The broken line in the proposed model distinguishes the right hemispheric mode of processing information, which relates to field dependence from the left hemispheric mode of processing information, which relates to field independence. The double line completes the model which now forms eight cells, each of which contains a predominant mode of processing information, a preferred cognitive style (i.e., field dependence/field independence), and a relative preference and expertise in regard to perception and judgment. These eight cells converge to form four basic personality types: Sensing/Thinking; Intuition/Thinking; Intuition/Feeling; and Sensing/Feeling.

The Myers-Briggs Type Indicator (MBTI) contains separate indices for determining each of the four basic preferences

represented in the model and the dominant process which structures an individual's learning style. It was hypothesized that individuals classified as dominant sensing (S) and dominant feeling (F) personality types were more likely to be field dependent and prefer right hemisphere processing modalities; while individuals classified as dominant thinking (T) and dominant intuitive (N) personality types were more likely to be field independent and prefer left hemisphere processing modalities. This study is an attempt to verify this hypothesis.

Several researchers have examined the relationship between cognitive style (field dependence/independence) and personality type as determined by the Myers-Briggs Type Indicator (Helson, 1966; Bissiri, 1971; Deines, 1974; Eggins, 1979; Novak, 1982). These studies have supported the relationship between a sensing personality type and field dependence and intuitive personality type and field independence, but to this writer's knowledge, there are no studies which have reported positive correlations between a feeling personality type and field dependence and a thinking personality type and field independence.

Newman (1977) postulated the relationship between the four Jungian functions (measured by the MBTI) and neural processing. Both the Newman model and the proposed learning style model place

the four functions (sensing, intuition, thinking, feeling) in the same position with respect to lateralization orientation.

A number of studies (Cohen, Berent, & Silverman, 1973; Berent, 1976; Oltman, Ehrlichman, & Cox, 1977; Berlin & Languis, 1981) have explored hemispheric correlates of an individual's cognitive style (field dependence/independence). These studies have demonstrated a relationship between field dependence and right hemisphere processing capabilities and strategies and field independence and left hemisphere processing capabilities and strategies.

Procedures

Twenty female elementary education majors at a large midwestern university volunteered during the 1981-1982 academic year for this study. Only twenty subjects were used due to the inordinate expense in terms of time in the use of the measurement instruments. The author coordinated the program, supervised field experiences and student teaching, and taught selected methods courses.

The subjects were administered the Myers-Briggs Type Indicator (Myers, 1962), a 166 item paper and pencil instrument, which determined the dominant personality type indicated in the model. This particular instrument was used to assess the personality

dimension for several reasons:

1. The instrument was designed to be used with normal subjects, and thus was not considered a personality measure of psychopathology.
2. The instrument was not designed to assess aptitude, but rather to indicate how much an individual relies on and employees one function or another. This capability of the MBTI allows the investigator to plot the personality dimension on a continuum, which was an important consideration in selecting all the instruments for this study.
3. The MBTI was designed to determine a subject's type preference of four-bipolar indices. This study only used two of those indices: sensing/intuition and feeling/thinking. Thus the MBTI was used to indicate the degree of preference between two dichotomous functions, which is what the EEG and cognitive style (field dependent/field independent) instruments further substantiated.
4. The reliability of the instrument has been investigated by several researchers (Mendelsohn, 1970; Stricker & Ross, 1962; Carlyn, 1977). Carlyn (1977) assessing the stability of type-category and continuous scores (N = 1371) using test-retest data found higher correlations than would be expected by chance. She concluded that the reliability for

the MBTI seemed reasonable for a self-report inventory (Carlyn, 1977). Most of the reliability tests conducted using Form F of the MBTI involve high school and college students. It appears that the stability of type preference increases with age, and therefore the Form F version of the MBTI is less reliable with junior-high students.

5. Numerous studies of construct validity summarized by Carlyn (1977) suggest that the individual scales of the MBTI measure important dimensions of personality which appear very similar to those postulated by Jung. Findings indicate that MBTI scores relate meaningfully to a large number of variables including personality, ability, interest, value and performance measures (Mendelsohn, 1970).

Within the realm of what can be expected of a theoretically based, self-report questionnaire, the MBTI represents a well-tested instrument to measure an extremely complex dimension. It was therefore decided that the MBTI would serve as the core of the proposed learning style model, for it had the capability of organizing diverse research.

The portable Rod and Frame Test (RFT), the Group Embedded Figures Test (GEFT) and the Concealed Figures Test (CFT) were administered to determine the cognitive style dimension (field dependent/field independent) represented in the learning process

model. The Rod and Frame Test (RFT) is an individually administered measure of field dependence/independence (Witkin, et al., 1962). The portable version of the RFT (Oltman, 1968) was used because it is less cumbersome. An experimental nonverbal procedure (Berlin & Languis, 1981) of the RFT was administered in order to assess spatial right-hemisphere cognitive processing. Test-retest reliabilities for the RFT have been consistently high. Witkin, Goodenough, and Karp (1967) computed reliability scores for 10 to 24 year olds in an extensive longitudinal study and reported .81 ($N=24$, $p < .01$) for females.

The Group Embedded Figures Test (GEFT) is a group administered measure of field dependence/independence modeled as closely as possible on the individually administered Embedded Figures Test (EFT) (Witkin, et al., 1962). It contains 18 complex figures, 17 of which were taken from the EFT. Gardner, Jackson and Messick (1960) reported a .95 reliability for college women on the EFT, from which the GEFT was modeled. Correlations between the RFT and versions of the EFT were statistically significant and generally in the .30-.65 range (Goldstein & Blackman, 1978).

The Concealed Figures Test developed by Thurstone and Jeffrey (1965) was designed to measure the subjects ability to hold a configuration in mind despite distraction and then visualize that configuration within a more complex drawing, diagram or figure.

The maximum raw score is 196 which would indicate an individual who can quickly and correctly see a given configuration in a complex drawing and therefore is considered field independent. Low scores on the CFT would indicate a relatively field dependent individual. Thurstone (1944) reports a split-half reliability coefficient of .78, for adult males. Trent (1974) reported a statistically significant ($p<.05$) correlation between the CFT and RFT.

Finally, an individual electroencephalogram (EEG) was recorded while each subject performed sequential-analytical and simultaneous-holistic (spatial) cognitive tasks associated with the left and right cerebral hemispheres respectively. Performance associated with the left hemisphere is typically verbal and logical-analytic, which is interpreted as a propositional mode of thought. To operationalize this definition, performance in the propositional mode was empirically indicated by selected items from two tests -- Inference Test and Deciphering Language Test (Kit of Factor Referenced Cognitive Tests - Ekstron, French, & Harmon, 1976). These tests require thinking which is verbal-categorical, logical-deductive and analytic.

Performance associated with the right hemisphere is typically nonverbal, spatial, gestalt-synthetic, which is interpreted as a simultaneous "appositional" mode of thought. To operationalize

this definition, performance in the simultaneous mode was empirically indicated by selected items from two tests: the Mooney Faces Test (Mooney, 1957) and the Mental Rotations Test (Vandenberg, 1978). These tests require thinking which may be characterized as gestalt-visual closure and spatial synthetic.

These performance tests which may involve greater participation of one hemisphere (i.e., that are lateralized to one hemisphere) were selected using four criteria: 1) the tasks could be supported in the literature (cf. Lyons, 1983), as indicators of performance laterality; 2) the tasks could be easily administered in a uniform manner with an attempt to control for stimulus characteristics; 3) a standard response mode could be developed for each task, thereby eliminating the need for limb movement or vocalization; 4) the tasks were feasible for the established response mode (subjects pushed a button to indicate their response from alternative responses).

In addition to these four cognitive tasks, which were administered to determine the functional specialization of the left and right cerebral hemispheres, the EEG protocol contained items to indicate the subjects field dependent and independent cognitive style and its relationship to hemispheric processing. Selected items from the Hidden Figures Test (Ekstrom et.al, 1976) were presented to the subjects to measure their ability to

disembed a simple figure from a more complex context.

There were two administrations of the five cognitive tasks presented in a booklet form. The subject read the directions and did a sample item before the EEG was recorded. All items were of a forced choice variety ranging in one to five choices. The subject was required to nonverbally respond to each task by pushing a button which illuminated a light for recording the answer.

According to Luria (1973) the principle of lateralization of higher function in the cerebral cortex begins to operate only with the transition to the secondary, and in particular, the tertiary zones. These zones are located in the posterior half of the cortex, generally where the occipital, temporal and parietal lobes merge into each other. Therefore, a bipolar (P3-T3 - left hemisphere; P4-T6 - right hemisphere) electrode placement was used. This bipolar placement is located at the junction of the tertiary zone. To assure accuracy of contact, impedence levels below 10,000 ohms (units of electrical resistance) were required. Comprehensive procedures for the EEG data collection and analysis are available (Lyons, 1983).

In addition to the quantitative measures, the subjects also kept self-analysis journals and discussed their learning patterns in the context of college courses and everyday living. These

diaries were written throughout the year long program and specifically designed to focus on varied aspects of the teaching/learning process.

Seminars were then conducted during the first quarter of the academic year which provided these students a theoretically sound learning processes framework, based on contemporary research in brain functioning. In addition, the pre-service teachers instructed students from kindergarten through fifth grade who were identified by their classroom teacher as learning disabled. These seminars, held in conjunction with the field component, provided a context in which neurological substrates of learning could be related to individual differences in learning style.

Once the subjects had developed a framework for understanding learning processes in general, they began to look at processing strategies. In the second quarter of the academic year, the subjects completed journal entries which focused on learning and teaching methodologies. The subjects identified a personal goal, not necessarily associated with academic work, which they aspired to accomplish in their lifetime and discussed learning strategies which would facilitate accomplishment of that goal. In addition, they indicated the processing strategies used to perform the CFT, GEFT, and RFT.

These prospective teachers were also enrolled in language arts and science methods courses during this second quarter and spent two afternoons per week teaching in grades K-5. In designing their weekly lessons, they were required to develop alternative methods for teaching science and language arts and then experiment with varied instructional strategies to meet individual learning needs. At the close of the quarter, the pre-service teachers journal entry was to discuss how knowledge of learning style and learning processes enabled them to better understand and develop alternative methodologies to meet individual learning needs.

At the beginning of the third quarter of the academic year, the focus of the journal entries was on the prospective teachers' estimation if the quantitative data analysis adequately reflected the qualitative data as written in their self-analysis journals. It must be established that no information was provided concerning the results of the quantitative measures (MBTI, CFT, GEFT, RFT, and EEG) until two weeks before the close of the third quarter. After the subjects were presented the results of the personality, cognitive style, and neural processing assessments, they were asked to strongly agree, moderately agree, or strongly disagree with each measure discussing their position in detail. In

addition the subjects discussed what relationship they saw between learning style and teaching style.

The researcher used these journal entries as well as formal lesson plans, weekly observations during student participation in the elementary schools, and informal interviews in order to describe qualitatively those relationships between the prospective teachers learning preference/style and teaching preference/style.

Analysis of Data (quantitative component)

The 20 completed MBTI questionnaires were hand scored. Raw scores were converted to continuous scores employing formulas developed by Myers (1962). These continuous scores determined the dominant function of the subjects. Raw scores for the CFT, GEFT, and RFT were calculated according to specifications in their respective manuals.

Several processes were required in order to analyze the cassette record of the raw EEG data. First, the output from the cassette recording was fed back through the F.M. converter, low pass filtered at $30H_z$, high pass filtered at $.5H_z$ and converted to a digital signal by the analog to digital converter. Next, the digital signal was immediately sent to the PDP 11/45 (Digital Equipment Corporation) for storage on an RKO 5 hard disc. After the digitized EEG record was stored, a Fast Fourier Transform program was performed. This program was designed to analyze the

percent of total activity per 4 H_z increment. In this study a ten second analysis increment with computer sampling of the digitized signal every .01 second was used. Therefore a total of 1024 samples per 10 second analysis was determined. An on-line print out of the data analysis was performed by the DEC writer (Digital Equipment Corporation). Print out was broken down into 4 H_z increments (.1 to 3.9, 4 to 7.9, 8 to 11.9, etc.) showing the percent of total power contained within each 4 H_z window. The print out displays one second epochs of analysis which is summed for the duration of the entire task. In this way, analysis of the electrical activity over the right and left hemispheres could be assessed while subjects performed each of the ten cognitive tasks. For this study, the sum of the activity in the alpha band (8-12 H_z) was divided by the sum of activity in three increments of the beta band (12-16 H_z, 16-210 H_z, and 20-24 H_z). Laterality was determined by computing the activity of the right hemisphere divided by the activity of the left hemisphere for each task.

The main analysis of this study determined the degree of correlation between the three constructs investigated: personality-indicated by the MBTI, neural processing - determined by the EEG, and cognitive style - measured by the CFT, GEFT, and RFT. Significant associations or relationships between these five tests were calculated by means of the SPSS Pearson Product Moment

correlation. These initial statistical procedures directly tested the hypotheses of this study.

Analysis of Data (qualitative component)

Content analysis was designed to assess two self-report journal entries directly related to learning preference/styles: 1) describe as fully as possible how they learn best; 2) discuss if the personality, cognitive style, and neural processing measures adequately reflect, somewhat reflect, or poorly reflect what you believe your learning preference/style to be.

Coding categories, identifying specific words and phrases which could be characterized as personality, neural processing, and cognitive style dimensions were used for the content analysis (see Table 1). A reliable and valid theory based on empirical evidence (neural functioning, Bogen, 1969; cognitive style, Witkin, 1962; and personality type, Jung, 1923) was used to develop the coding categories. Each category served a purpose and delineated a meaningful dimension of the variables under study.

Insert Table 1 about here

Three individuals were trained to evaluate the self-report journals. The researcher conducted two training sessions to

explain the procedures to follow for this analysis. In the first session the content areas of the study (neural processing, personality theory, and cognitive style) were defined "conceptually" and "functionally". The theoretical framework, which included the assumptions and perspectives the writer held, were delineated and the theory upon which the coding instrument was based was defined and outlined. Specific words and phrases which identified the constructs to be investigated were examined.

In the second session, step by step procedures the three coders should follow in sorting the responses were outlined. Examples from a pilot study (Lyons, 1983) were provided to familiarize the coders with the content analysis process. Rules for assigning the responses to the hypothetical coding categories were explained. Included in these rules were: (1) the degree to which coders should "read into" the responses; i.e., how much should the coder make inferences; (2) the criteria for determining uncodable responses; (3) procedures to follow when a response does not seem to fit into a category; (4) procedures for handling "problem" responses, including omissions, cryptic or undecipherable responses, responses which can be placed into more than one category, "I don't know"; "no comment"; "does not apply", etc., responses; (5) the scoring algorithm for determining the final coding score was explained.

Journal entries which were to be coded were duplicated and presented to the three raters along with the coding scheme, which delineated words or phrases for classifying the subjects' responses, coding procedures for content analysis of the twenty protocols, and a summary sheet designed to summarize the data and determine if the subjects' could be characterized as having a more dominant sensing or feeling, field dependent, simultaneous processing learning style profile or a more dominant intuitive or thinking, field independent, successive processing learning style profile.

Quantitative Results

According to the theory and proposed model, subjects identified as dominant sensing or dominant feeling personality types (determined by the MBTI) were more likely to be characterized as field dependent on the three measures of cognitive style (CFT, GEFT, RFT) and prefer right hemisphere processing modalities (determined by EEG). Individuals characterized as dominant intuitive or dominant thinking personality types (determined by the MBTI) on the other hand, were more likely to be characterized as field independent on the three measures of cognitive style and prefer left hemisphere processing modalities (determined by EEG). Table 2 presents the results of

the Pearson Product Moment Correlation which determined the degree of correlation between the three constructs investigated.

Insert Table 2 about here

Results are discussed in terms of answers to specific questions.

<u>What is the relationship between neural processing and cognitive style</u>?

For the total group (N=20), the correlations between total EEG and GEFT (-.37) and total EEG and RFT (+.53) were significant in the hypothesized direction. While the correlations between the total EEG and the CFT (-20) did not reach the .05 level of significance, it did correlate in the expected direction. This evidence suggests that all three measures of cognitive style administered to the total group in this study support the theory postulated in the proposed learning style model in the hypthesized direction.

<u>What is the relationship between personality types (sensing/intuitive; thinking/feeling) neural processing, and cognitive style</u>?

Table 2 shows that for the sensing/intuitive group (N-10), the total EEG was a significant correlate of the CFT (-.53); and for the thinking/feeling group N=10) total EEG was a significant correlate of the RFT (.76). In both instances the cognitive style

measures reflected the EEG lateralization in the hypothesized direction. These results indicate that for the sensing/intuitive group the CFT is more likely to indicate neural processing activation, whereas for the thinking/feeling group, the RFT (non-verbal administration) tends to be a better predictor of neural processing.

What is the relationship between a dominant sensing personality type and field dependence and a dominant intuitive personality type and field independence?

The results reported on Table 2 suggest that all three measures of cognitive style correlate with the dominant sensing/intuitive personality types in the hypothesized direction, however, none of these correlations reached the desired $<.05$ level of significance.

What is the relationship between a dominant thinking personality type and field independence and a dominant feeling personality type and field dependence?

Inspection of Table 2 reveals a significant correlation in the hypothesized direction between thinking/feeling scale on the MBTI and the CFT ($R=-.48$; $p<.01$); however, the relationship was not supported on the GFT ($R=+.01$) or RFT ($R=-.22$).

What is the relationship between a dominant sensing personality type and right hemisphere activation and a dominant intuitive personality type and left hemisphere activation?

Table 2 shows that the sample correlation ($N=10$) supports the

relationship in the hypothesized direction, however, it did not reach the desired .05 level of significance.

What is the relationship between a dominant thinking personality type and left hemisphere activation and a dominant feeling personality type and right hemisphere activation?

Inspection of Table 2 reveals that the thinking/feeling scale on the MBTI correlated significantly with the EEG in an opposite direction than what was expected. Possible explanation for why this negative correlation may be that the sample distribution was small (N=10), contained a few very extreme scores, and was badly skewed.

The Pearson Correlation Coefficients were computed using the mean total activation score for 10 subjects across 10 cognitive tasks. The preceeding analysis focused on group data which can conceal important individual differences. Inspection of laterality trends reported on Table 3 for individuals classified as dominant sensing, intuitive, thinking, and feeling types on the MBTI demonstrate that five of the eight dominant feeling personality types demonstrated greater right hemisphere activation, which suggests support for the theory and model.

Insert Table 3 about here

The results reported on Table 3 indicate that fourteen of the twenty subjects MBTI dominant function (70% of the sample) reflect neural processing activation in the hypothesized direction.

Table 4 presents data which focuses on the four dominant MBTI functions individually and their relationships to cognitive style.

Insert Table 4 about here

When examining each of the three cognitive style measures separately and determining if the instrument reflected the field dependent/independent cognitive style in the hypothesized direction suggested by the MBTI dominant function, 16 GEFT scores, 16 CFT scores, and 8 RFT scores did reflect the direction postulated in the learning style model (Table 4).

To summarize the quantitative data analysis, it appears that there was support for the theory postulated in the learning style model. Greater support for the theory and model, however, was gleaned when one examined the neural processing and cognitive style trends of learners with specific personality characteristics (see Tables 3 and 4). With such a small sample size, the fact that there were identifiable cognitive style and neural processing trends among individuals which consistently supported the

theoretical assumptions underlying the learning style model, suggest that the hypotheses presented are reasonable.

It must be kept in mind that within cognitive style models, individual differences (presented in the trend analysis), rather than group differences (presented in the statistical analysis) are more valuable for designing instructional strategies, especially as they relate to cognitive processes and structures. It is these process oriented individual differences, not group differences, which have promise for making applications of a learner's cognitive processes to pedagogy. Nevertheless, this aspect of this study should be replicated with a larger sample.

Qualitative Results

Only the first and last journal entries were analyzed using content analysis. To ensure objectivity in coding these entries for the twenty subjects according to the established coding categories (Lyons, 1983), percentages of agreement were obtained from three raters -- two males and one female, who were experimentally naive. All raters scored the three entries independently of each other according to established procedures. Interrater reliability was .87.

The first journal entry (i.e., describe as fully as possible how you learn best) served as a pretest. The results indicated that six individuals believed they were more sensing or feeling,

field dependent, simultaneous processors compared to fourteen individuals who documented a more intuitive or thinking, field independent, successive processing learning style.

In the last journal entry the subjects were asked to discuss if the quantitative results adequately reflected, somewhat reflected, or poorly reflected what they believed their learning preference/style to be. This entry served as a posttest and documented how knowledge about learning processes facilitates an individual's understanding of their own learning preferences. The results indicated that thirteen subjects were either dominant sensing or feeling, field dependent, simultaneous processors, while seven subjects indicated that they were dominant intuitive or thinking, field independent, successive processors. This discrepancy between the pretest and posttest data may be a testimonial to the subjects' having experienced sixteen years of schooling. Students tend to learn to conform to the teaching style they are exposed to most.

The completed journals, weekly lesson plans and observations, and informal interviews conducted throughout the academic year suggested a relationship between learning preferences/style and teaching preferences/style.

Insert Table 5 about here

Table 5 reports the relationship between a dominant intuitive or thinking, field independent, successive processing learning style preference and teaching style.

Insert Table 6 about here

Table 6 reports the relationship between a dominant sensing or feeling, field dependent, simultaneous processing learning style preference and teaching style.

Summary

The results of this study provide a basic framework upon which to build a sound theory describing the relationship between learning preference/style and teaching/preference style. They also provide valuable insights from both a quantitative and qualitative perspective concerning the teaching/learning process.

First, an individual's learning style is a composite of several variables (i.e., personality, cognitive style, and neural processing). Therefore, learning style needs to be conceptualized in terms of deeply embedded structures within the individual, not as an individual's response to environmental conditions (e.g.,

light, sound) or other specific aspects of the learning environment (Languis, 1981). This notion that one's learning style is the result of deeply embedded structures suggests that it is somewhat stable, but not fixed (Bem & Allen, 1974). Second, once prospective teachers understand the theoretical concepts and constructs of their own learning, they can begin to identify those learning behaviors in themselves and in the students they are instructing which reflect these deeply embedded structures. Finally, there are identifiable teaching behaviors/styles which reflect learning preferences/style.

Implications

The insights gained from this study and the wide variety of research which has explored how students learn should add to our body of information concerning the teaching/learning process. I believe, that given the interdisciplinary scope and complexity in understanding individual differences in learning and teaching, future researchers should use a theoretically based model to develop hypotheses. Such a model has been presented and research has been initiated to verify the model and theory it represents. Additional empirical research however, must be conducted in order to validate, modify, or expand upon the proposed learning style model.

Pre-service teachers are just beginning to develop a rationale for educational practices. In providing them an opportunity to become aware of individual differences in learning and teaching, they can begin to know, understand and accept their own learning style and strengths, while developing a healthy respect for the uniqueness of others' learning preferences. Once teachers are encourage to explore and strengthen their abilities to learn and teach in alternative modes without the pressure of being wrong, wholeness and excellence in educational practices may be attained.

Dr. Madeline Hunter, in her 1976 address to the National Institute of Education task force on curriculum development for teacher education programs stated:

> Students everywhere are exerting effort to learn, but nowhere (to the writer's knowledge) are students systematically learning <u>how</u> to learn more efficiently and effectively. As a result, we find students routinely using assembly line learning procedures unaware that they could know their own best learning modalities, the strategies that work for them, the most productive way for them to become more motivated to learn more rapidly, remember longer, and transfer that learning successfully to new situations. In short, although individualization of instruction is preached, students are

not learning the skills to deal with the idiosyncratic dimensions of their own learning behavior (p.5).

The teacher education program described above demonstrates that the basic teacher education "learning how to learn" curriculum advocated by Madeline Hunter in 1976 can be implemented.

Figure 1

Neural Processing, Cognitive Style, Personality Type Learning Style Model

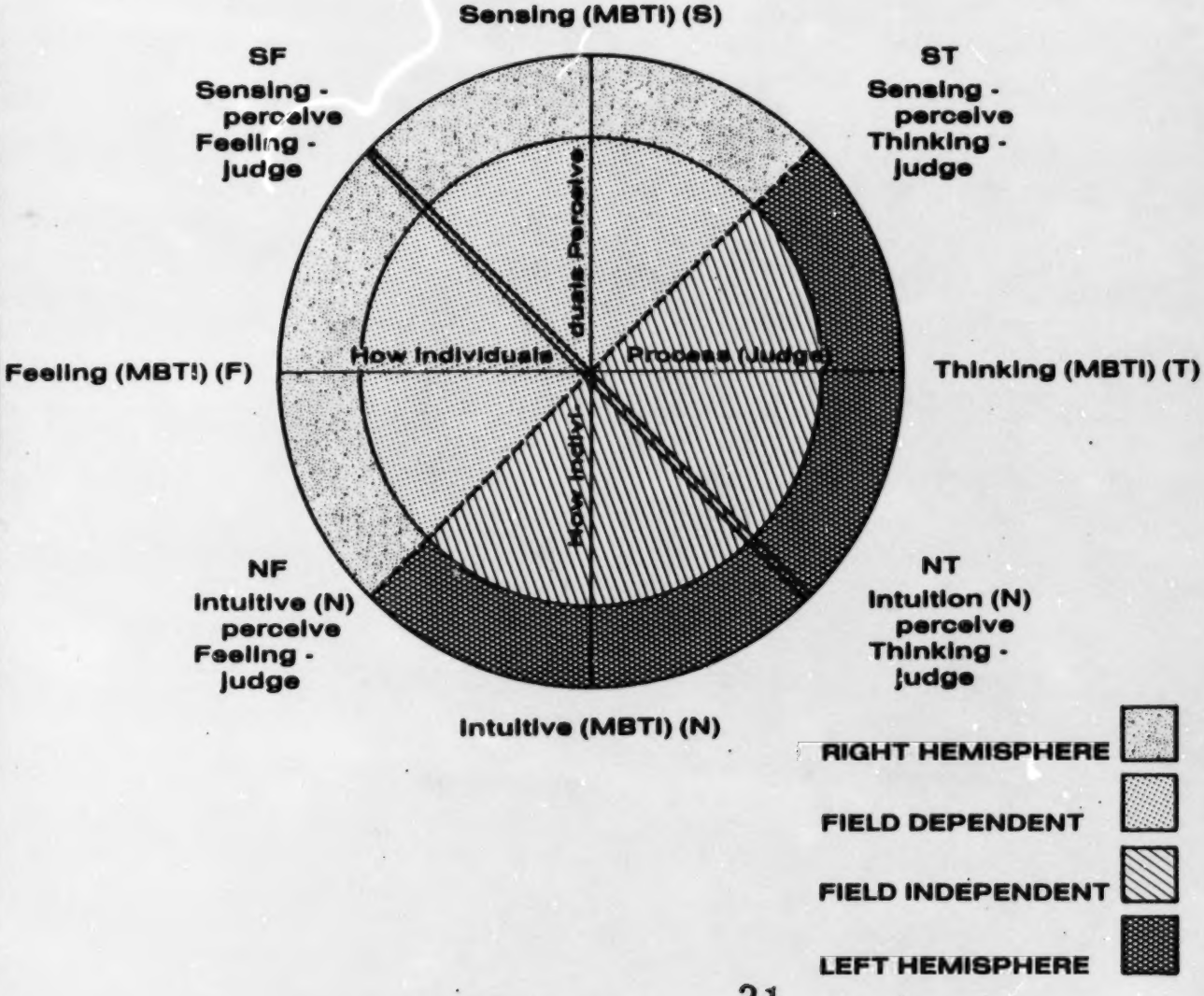

TABLE 1

PROCESSING AND ORGANIZING INFORMATION
CODING CATEGORIES

Dominant Sensing or Feeling Field Dependent Simultaneous Neural Processing Preference		Dominant Intuitive or Thinking Field Independent Successive Neural Processing Preference	
01	non-verbal	101	verbal
02	synthetic	102	analytic (MBTI-thinking)
03	reasoning not as logical	103	reasoning logical (MBTI-thinking)
04	concrete (MBTI-sensing)	104	abstract (field independent)
05	divergent	105	convergent
06	inductive	106	deductive
07	non-temporal	107	temporal
08	experience/hands on learning (MBTI sensing)	108	symbolic learning (MBTI-intuitive)
09	gestalt-holistic	109	linear (MBTI-thinking)
10	spatial	110	digital
11	stores memories in images	111	stores memories in words
12	prefers random exploration	112	(MBTI-intuitive)prefers ordering and sequencing (field independent)
13	summarizes material	113	outlines material
14	looks for the main idea in reading material	114	looks for details and facts in reading material
15	concrete manipulation	115	abstract thinking (field independent)
16	infers from feelings	116	infers from facts
17	reads facial expression/gestures	117	listens to articulation of words
18	prefers non-structured environment	118	prefers a more structured environment
19	prefers to learn social material (field dependent) (MBTI feeling)	119	prefers to learn impersonal material (field independent) (MBTI-thinking)
20	people oriented (field dependent) (MBTI-feeling)	120	subject matter oriented (field independent) (MBTI-thinking)
21	prefers physical sciences (field dependent)	121	prefers physical sciences (field dependent)
22	generally prefers essay exam (dependent)	122	generally prefers objective exam
23	social reinforcement needed - praise or criticism for behavior (field dependent) (MBTI-feeling)	123	does not need social reinforcement for behavior (MBTI-thinking)

TABLE 2

INTERCORRELATIONS BY SENSING/INTUITIVE, THINKING/FEELING, AND TOTAL GROUP

N = 20

Variable	Group	N	1	2	3	4	5
1 MBTI	Total	20	1.00	-.17	.18	-.07	-.19
	S/N	10	1.00	-.29	.37	.35	-.18
	T/F	10	1.00	-.56[a]	.01	-.48[b]	-.22
2 Total EEG	Total	20		1.00	-.37[a]	-.20	.53[b]
	S/N	10		1.00	-.33	-.53[a]	.37
	T/F	10		1.00	-.38	.02	.76[b]
3 GEFT	Total	20			1.00	.42[a]	-.77[c]
	S/N	10			1.00	.59[a]	-.91[c]
	T/F	10			1.00	.22	-.71[b]
4 CFT	Total	20				1.00	-.26
	S/N	10				1.00	-.60[a]
	T/F	10				1.00	-.10
5 RFT (Reflected)	Total	20					1.00
	S/N	10					1.00
	T/F	10					1.00

[a] $p < .05$ [b] $p < .01$ [c] $p < .001$

(observed significant levels reported are one-tailed)

Note: A non-verbal administration of the RFT was employed.

TABLE 3

EEG RELATIONSHIP TO MBTI

MBTI Dominant Function	Overall Mean Alpha/Beta Activation	Direction
ISFJ	$\bar{x}$ 1.26	RH*
ISFJ	$\bar{x}$ 1.22	RH*
ESFP	$\bar{x}$ 1.01	RH*
ISFJ	$\bar{x}$ .92	LH
ISTJ	x .81	LH
ENFP	$\bar{x}$ .66	LH*
ENFP	$\bar{x}$ .93	LH*
ENFP	$\bar{x}$ .94	LH*
ENFP	$\bar{x}$ .97	LH*
ENFP	x .99	LH*
INTP	$\bar{x}$ .81	LH*
ISTP	x 1.73	RH
ESFJ	$\bar{x}$ 2.06	RH*
ESFJ	$\bar{x}$ 1.46	RH*
ESFJ	$\bar{x}$ 1.44	RH*
ISFP	$\bar{x}$ 1.07	RH*
ESFJ	$\bar{x}$ 1.02	RH*
INFP	$\bar{x}$ .93	LH
INFP	$\bar{x}$ .89	LH
ISFP	x .83	LH

*MBTI dominant function correlates in the hypothesized laterality direction.

TABLE 4

GEFT, CFT, RFT RELATIONSHIP TO MBTI

MBTI Dominant Function	GEFT	CFT	RFT
ISFJ	FD	FD	FD
ISFJ	FD	FD	FID
ISFJ	FID	FID	FID
ISTJ	FID	FID	FD
ESFP	FD	FD	FD
ENFP	FID	FID	FID
ENFP	FID	FID	FID
ENFP	FID	FID	FID
ENFP	FID	FID	FID
ENFP	FID	FID	FID
INTP	FID	FID	FID
ISTP	FID	FID	FID
ESFJ	FD	FD	FD
ESFJ	FD	FID	FID
ESFJ	FD	FD	FD
ESFJ	FD	FD	FID
INFP	FD	FID	FID
INFP	FID	FD	FID
ISFP	FID	FD	FID
ISFP	FD	FD	FID

FD - field dependent
FID - field independent

TABLE 5
LEARNING AND TEACHING BEHAVIOR PROFILE
OF A
DOMINANT INTUITIVE OR THINKING, FIELD INDEPENDENT, SUCCESSIVE PROCESSOR

Learning Style	Teaching Style
1. Approaches learning task in an orderly, sequential, analytic manner.	1. Generally well organized and plans lessons in a definite sequence, systematically adding bits and pieces together to gain larger understandings.
2. Prefers to read and outline material to be learned.	2. Lecture - highlighting specific items children should take notes on.
3. Organizes daily and weekly activities according to a specific time table.	3. Organizes daily and weekly lessons in an temporal way with specified amounts of time allotted to each subject.
4. Infers meaning from facts presented.	4. Tends to analyze teaching methods and strategies, weighing the facts objectively and making decisions about the lesson based on logic.
5. Stores memories in words and prefers objective exams.	5. Prefers to test material learned objectively.

TABLE 6
LEARNING AND TEACHING BEHAVIOR PROFILE
OF A
DOMINANT SENSING OR FEELING, FIELD DEPENDENT, SIMULTANEOUS PROCESSOR

Learning Style	Teaching Style
1. Approaches learning task in a random, holistic manner.	1. Generally organized curricula more globally looking at the interrelatedness of the content; preferred themeatic approach
2. Prefers to learn through direct observation and first-hand experience.	2. Emphasizes learning by doing, experimentation, observation
3. Has no definite time table or sequence of daily and weekly activities.	3. Management of time is flexible. If the children are highly motivated and interested in a lesson or if an unexpected learning situation occurs, she/he will take advantage of the learning opportunity rather than stop the lesson because the allotted time was over.
4. Infers meaning from feelings and facial expressions (non-verbal communication).	4. Tends to analyze teaching methods and strategies according to how the students felt about the lesson and the nonverbal cues they demonstrated.
5. Stores memories in images and pictures, preferring essay or lab exams.	5. Prefers more informal evaluation of information gained.

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